

# NUCLEAR SCIENCE AND ENGINEERING<sup>®</sup>

(ISSN: 0029-5639)

THE RESEARCH JOURNAL OF THE AMERICAN NUCLEAR SOCIETY

## ANS OFFICERS

Joseph M. Hendrie  
*president*

E. Linn Draper, Jr.  
*vice-president/president-elect*

John Graham  
*treasurer*

Raymond D. Maxson  
*assistant treasurer*

Octave J. Du Temple  
*executive director*

## ANS PUBLICATIONS STAFF

V. Michael Diekman  
*publications manager*

Susan Hollensteiner  
*administrative assistant*

Margaret A. Clemons  
*copy editor*

Gene O. Macke  
*copy editor*

Susan Kuehl  
*editorial assistant*

Andall S. Bilot  
*production manager*

## COMPOSITION

Elgin, Dexter, Michigan 48130

Indexed in "Engineering Index" and  
abstracted in "INIS Atom Index"

JOHN M. KALLFELZ, *Editor*

ELFRIEDE H. KALLFELZ, *Editorial Assistant*  
SILVIA MIGENDA, *Editorial Assistant*

Nuclear Engineering and Health Physics Program  
School of Mechanical Engineering  
Georgia Institute of Technology  
Atlanta, Georgia 30332 USA

DAN G. CACUCI, *Associate Editor*

Engineering Physics & Mathematics Division  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee 37831 USA

GÜNTHER KESSLER, *Associate Editor, Europe*

ANTON BAYER, *Editorial Assistant*

Kernforschungszentrum Karlsruhe  
Postfach 3640  
D-7500 Karlsruhe 1  
Federal Republic of Germany

## Volume 88 September, October, November, December 1984

NUCLEAR SCIENCE AND ENGINEERING (ISSN: 0029-5639) is published monthly by the American Nuclear Society, Inc., with business offices at 555 N. Kensington Ave., La Grange Park, Illinois 60525; telephone 312/352-3111. The subscription rate is \$108 per volume or \$280 for three volumes per calendar year; overseas subscribers add \$85 per year for postage and handling. Single copy price is \$38 for current and back issues. Inquiries about the distribution and delivery of NUCLEAR SCIENCE AND ENGINEERING and requests for changes of address should be directed to the American Nuclear Society. Allow four weeks for a change to become effective. POSTMASTER: Send change of address orders to the American Nuclear Society. NUCLEAR SCIENCE AND ENGINEERING is printed in Danville, Illinois 61832, by Interstate Printers and Publishers, Inc. Second-class postage is paid at La Grange, Illinois, and at additional mailing offices. Copyright © 1984 by the American Nuclear Society, Inc. Trademark registered in Canada. Findings reported and opinions expressed in this publication by the authors are their own and do not necessarily

reflect the opinions of the editors, the American Nuclear Society, or the organizations with which the authors are affiliated, nor should publication of author viewpoints or identification of materials or products be construed as endorsement by this publication or the Society. The address of the editorial office is: NUCLEAR SCIENCE AND ENGINEERING Journal, Nuclear Engineering and Health Physics Program, Cherry Emerson Bldg., Georgia Institute of Technology, Atlanta, Georgia 30332, USA (see inside of back cover for more details).

PHOTOCOPYING: Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by the AMERICAN NUCLEAR SOCIETY to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$3.00 per copy is paid directly to CCC, 21 Congress St., Salem, MA 01970; 0029-5639/84 \$3.00. Consent is not given for other copying, such as for general distribution, advertising or promotional, creating new collective works, or resale.



Copyright © 1984 by American Nuclear Society, Inc., La Grange Park, Illinois 60525

Volume 88  
Supplement October  
November 1984

# Contents of Volume 88

NUMBER 1, SEPTEMBER 1984

## TECHNICAL PAPERS

- 1 Neutron and Gamma-Ray Physics in Fast Reactor Blankets *K. O. Ott, F. M. Clikeman, G. A. Harms*
- 16 Symbiosis of Coupled Systems of Fusion D-<sup>3</sup>He Satellites and Tritium and <sup>3</sup>He Generators *Magdi Ragheb, Saman Behtash*
- 37 Measurements of the Neutron Fission Cross Sections of <sup>235</sup>U ( $E_n = 0.01$  eV to 30 keV) and <sup>239</sup>Pu ( $E_n = 0.01$  to 60 eV) *R. Gwin, R. R. Spencer, R. W. Ingle, J. H. Todd, S. W. Scoles*
- 56 Evaluation and Testing of  $n + ^{239}\text{Pu}$  Nuclear Data for Revision 2 of ENDF/B-V *E. D. Arthur, P. G. Young, D. G. Madland, R. E. MacFarlane*
- 71 Fitted Temperature-Corrected Compton Cross Sections for Monte Carlo Applications and a Sampling Distribution *B. R. Wienke, B. L. Lathrop, J. J. Devaney*
- 77 On the Neutron Noise Diagnostics of Pressurized Water Reactor Control Rod Vibrations II. Stochastic Vibrations *I. Pázsit, O. Glöckler*

## TECHNICAL NOTES

- 88 Investigation of Stochastic Reactor Noise Models—A One-Variable Space-Time-Dependent Model *L. Meskó, R. Kozma*
- 94 The Verification of the Moderator Response Function via Watson Transform *Kojiro Nishina, Shoji Watanabe*
- 97 The <sup>12</sup>C( $n, n'$ )<sup>3</sup> $\alpha$  Cross Section up to 60 MeV *D. J. Brenner, R. E. Prael*

# Contents of Volume 88

(Continued)

NUMBER 2, OCTOBER 1984

## TECHNICAL PAPERS

- 103 A Two-Dimensional Two-Group Albedo Model for Pressurized Water Reactor Reflector *Yung-An Chao,  
Chang-An Suo*
- 110 A Simple Expression for Radiation Dose Rate Distributions Around a Cylindrical Shell Source with a Finite Height *Hisao Yamakoshi*
- 123 Absolute Measurement of the Cross Section for 23-keV Neutron Activation of Thorium *George T. Baldwin,  
Glenn F. Knoll*
- 129 Resonance Neutron Capture by  $^{39,41}\text{K}$  *R. L. Macklin*
- 143 Measurement of  $(n,p)$  and  $(n,\alpha)$  Reaction Cross Sections on Some Isotopes of Nickel in the Energy Region of 5 to 10 MeV Using a Deuterium Gas Target at a Compact Cyclotron *S. M. Qaim, R. Wölfle,  
M. M. Rahman, H. Ollig*
- 154 Semiempirical Description of the Mass Distribution for the  $^{238}\text{U}(n,f)$  Process in the 1.5- to 15-MeV Energy Interval *S. Nagy, S. Daróczy,  
P. Raics, I. Boda, I. Matajsz*
- 164 Depolarization Effects in Resonance Absorption Neutron Polarization Filters *J. Mayers*
- 173 A General Method for Optimal Design of Nondestructive Assay Systems *Nathan Shenhav,  
Yakov Ben-Haim*

## TECHNICAL NOTES

- 184 Temperature Dependence of Fission Product Release Rates *James L. Kelly,  
A. B. Reynolds,  
Michael E. McGown*
- 191 Fast Reactor Transient Analysis Using the Generalized Quasi-Static Approximation *J. Devooght, E. H. Mund,  
B. Arien, A. Siebertz*

## BOOK REVIEW

- 200 Reliability and Risk Analysis—Methods and Nuclear Power Applications, Norman J. McCormick *Stan Kaplan*

## CORRIGENDUM

- 201 Monte Carlo Calculation and Analytical Approximation of Gamma-Ray Buildup Factors in Air *P. Jacob, H. G. Paretzke,  
J. Wölfel*

# Contents of Volume 88

(Continued)

NUMBER 3, NOVEMBER 1984

## NUCLEAR REACTOR THERMAL HYDRAULICS

- 203 Editorial *The Editors*
- 205 Preface: Nuclear Reactor Thermal Hydraulics *S. Levy, S. Banerjee,  
T. G. Theofanous, Y. Y. Hsu*

## TECHNICAL PAPERS

- 206 Heat Transfer in Rod Bundles with Severe Clad Deformations *P. Ihle*
- 220 Thermal Hydraulics of Valves for Nuclear Applications *Dirse W. Sallet*
- 245 Valve Qualification for Normal and Accident Conditions in Light Water Reactors *B. Dernbach, K. Riedle,  
U. Simon*
- 261 Two-Phase Critical Flow in Slits *C. N. Amos, V. E. Schrock*
- 275 Experimental Study of Two-Phase, Two-Component Flow in Centrifugal Pumps *Juan J. Manzano-Ruiz,  
David Gordon Wilson*
- 287 De-Entrainment of Liquid on Vertical Rods in Air/Water Cross Flow *Ramu K. Sundaram,  
John C. Chen,  
John C. Dallman*
- 297 Flow Through a Small Break at the Bottom of a Large Pipe with Stratified Flow *J. Reimann, M. Khan*
- 311 Natural Circulation Cooling in a Pressurized Water Reactor Geometry Under Accident-Induced Conditions *D. J. Shimeck,  
G. W. Johnsen*
- 321 Effect of System Pressure on Film-Boiling Heat Transfer, Minimum Heat Flux, and Minimum Temperature *Akira Sakurai,  
Masahiro Shiotsu,  
Koichi Hata*
- 331 A Study of Subcooled Film-Boiling Heat Transfer Under Reactivity-Initiated Accident Conditions in Light Water Reactors *Nobuaki Ohnishi,  
Kiyomi Ishijima,  
Sadamitsu Tanzawa*
- 342 Aerosol Source Term in High Pressure Melt Ejection *J. E. Brockmann,  
W. W. Tarbell*
- 357 Erosion of Steel Structures by High-Temperature Melts *D. A. Powers*

(Continued)

# Contents of Volume 88

(Continued)

NUMBER 3, NOVEMBER 1984

- 367 Monitoring Reactor Vessel Liquid Level with a Vertical String of Self-Powered Neutron Detectors *J. P. Adams, V. T. Berta*
- 376 Fluid Dynamic Effects in the Fuel Element Top Nozzle Area During Refilling and Reflooding *A. Hawighorst, H. Kröning, F. Mayinger*
- 386 An Experimental Study of Blowdown Thrust and Jet Forces for a Pipe Under Boiling Water Reactor Loss-of-Coolant Accident Conditions *T. Yano, T. Isozaki, S. Ueda, N. Miyazaki*
- 396 Comparison of Calculated and Measured Fluid Jet Impingement Velocities in a Simulated Reactor Geometry *A. K. Hertrick, R. A. Riddell, R. E. Schwirian, G. M. Dorogy, W. J. Bryan, R. J. Hopkins*
- 404 NUFREQ-NP: A Computer Code for the Stability Analysis of Boiling Water Nuclear Reactors *S. J. Peng, M. Z. Podowski, R. T. Lahey, Jr., M. Becker*
- 412 A CANDU Figure-of-Eight Flow Stability Model *P. Gulshani, N. J. Spinks*
- 425 Degraded Cooling in a CANDU Reactor *R. A. Brown, C. Blahnik, A. P. Muzumdar*
- 436 Hydrogen Combustion in Aqueous Foams *M. R. Baer, S. K. Griffiths, J. E. Shepherd*
- 445 Thermal-Hydraulic Characteristics in a Liquid-Metal Fast Breeder Reactor Hot Plenum *Nobukazu Tanaka, Shoichi Moriya, Akira Wada*
- 464 Boiling and Dryout Conditions in Disturbed Cluster Geometry and Their Application to the Liquid-Metal Fast Breeder Reactor Local Fault Assessment *K. Yamaguchi, H. Nakamura, K. Haga*

# Contents of Volume 88

(Continued)

NUMBER 4, DECEMBER 1984

## TECHNICAL PAPERS

- 475** An Investigation of Neutral-Beam-Driven Impurity Flow Reversal as an Impurity Control Method in Future Tokamaks *R. B. Bennett,  
W. M. Stacey, Jr.*
- 486** Performance of Pairs of Hafnium and Rhodium Self-Powered In-Core Detectors in a Pressurized Water Reactor *H. D. Warren,  
C. T. Rombough,  
T. G. Pitts, M. L. Gilbert*
- 495** Droplet Size Distribution from Bulk Flashing *R. C. Anderson,  
C. A. Erdman,  
A. B. Reynolds*
- 513** Some Observations of the Two-Dimensional Neutron Noise Field Generated by a Moving Neutron Absorber Located in the Reflector Region of a Low Power Reactor *William J. Hennessy,  
R. A. Danofsky,  
R. A. Hendrickson*
- 522** System Transfer Function Applications in Neutron Radiographic Object Scattering *D. R. Wyman, A. A. Harms*
- 537** Hadronic Event Generation for Hadron Cascade Calculations and Detector Simulation—Part I: Inelastic Hadron/Nucleon Collisions at Energies Below 5 GeV *K. Hänßgen, J. Ranft*
- 551** Hadronic Event Generation for Hadron Cascade Calculations and Detector Simulation—Part II: Inelastic Hadron/Nucleus Collisions at Energies Below 5 GeV *K. Hänßgen, H.-J. Möhring,  
J. Ranft*
- 567** Subthreshold Fission Cross Section of  $^{240}\text{Pu}$  and the Fission Cross Sections of  $^{235}\text{U}$  and  $^{239}\text{Pu}$  *L. W. Weston, J. H. Todd*
- 579** Neutron Total Cross Sections of  $^{181}\text{Ta}$  and  $^{238}\text{U}$  from 24.3 keV to 1 MeV and Average Resonance Parameters *Izumi Tsubone,  
Yutaka Nakajima,  
Yutaka Furuta,  
Yukinori Kanda*

## TECHNICAL NOTES

- 592** Plasma Energy Deposition from the Nuclear Elastic Scattering of Tritons on Tritons *Joseph J. Devaney*

(Continued)

# Contents of Volume 88

(Continued)

NUMBER 4, DECEMBER 1984

- 594 The Capture Width of the 34.8-keV *s*-Wave Neutron Resonance in  $^{27}\text{Al}$

*K. Wisshak, F. Käppeler,  
G. Reffo*

- 598 On the Effect of Scission Neutrons on  $\nu(A)$  Data for  $^{252}\text{Cf}(sf)$

*R. L. Walsh,  
J. W. Boldeman*

## BOOK REVIEW

- 601 Principles of Radiation Shielding, Arthur B. Chilton, J. Kenneth Shultz, Richard E. Faw

*Lewis V. Spencer*

## 602 VOLUME 88 AUTHOR AND SUBJECT INDEXES

STATEMENT REQUIRED BY THE ACT OF OCTOBER 23, 1962, SECTION 4369, TITLE 39, UNITED STATES CODE, SHOWING OWNERSHIP, MANAGEMENT, AND CIRCULATION OF NUCLEAR SCIENCE AND ENGINEERING. Published monthly at 555 N. Kensington Avenue, La Grange Park, Illinois 60525, for December 1984. The general business offices of the Publisher are located at the same address. Publisher: The American Nuclear Society, Incorporated. Publications Production Manager: Randall S. Bilo. Address either at 555 N. Kensington Avenue, La Grange Park, Illinois 60525. Editor: John M. Kallfelz, Georgia Institute of Technology, Atlanta, Georgia 30332. Owner: The American Nuclear Society, Incorporated, 555 N. Kensington Avenue, La Grange Park, Illinois 60525, a nonprofit membership corporation organized under the laws of the State of New York. It is exempted from federal taxation. Its officers are PRESIDENT, Joseph M. Hendrie, 50 Bellport Lane, Bellport, New York 11713; VICE-PRESIDENT, E. Linn Draper, Jr., Gulf States Utilities, P.O. Box 2951, Beaumont, Texas 77704; TREASURER, John Graham, Rockwell International, B.W.I.P., P.O. Box 800, Richland, Washington 99352; EXECUTIVE DIRECTOR, Octave J. Du Temple, American Nuclear Society, La Grange Park, Illinois 60525. Its known bondholders, mortgagees, and other security holders owning or holding one percent or more of the total bonds, mortgages, or other securities are: none. The average number of copies of each issue during the preceding 12 months is: (A) Total number of copies printed (net press run): 2138; (B) Paid circulation: (1) to term subscribers by mail, carrier delivery, or by other means: 1466; (2) sales through agents, news dealers, or otherwise: none; (C) Free distribution (including samples) by mail, carrier delivery, or by other means: 15. Total number of copies distributed: 1481. The number of copies of a single issue nearest to filing date is: (A) Total number of copies printed (net press run): 2200; (B) Paid circulation: (1) to term subscribers by mail, carrier delivery, or by other means: 1287; (2) sales through agents, news dealers, or otherwise: none; (C) Free distribution (including samples) by mail, carrier delivery, or by other means: 19. Total number of copies distributed: 1306. I certify that the statements made by me above are correct and complete. (Signed) Julie R. Kloos, Production Assistant.